Search for a variation of the proton-electron mass ratio from molecular hydrogen and methanol

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The standard model (SM) of particle physics is a theory with remarkable predictive power. One great example of its success is the recent discovery of the Higgs boson. However, at the same time the SM is incompatible with general relativity – a theory tested and trusted just as much. Furthermore, certain ad hoc features maintained by the SM indicate that its explanatory insights are not as broad and exhaustive as one would hope. One of the features that looks arbitrary is the number and the values of the free parameters of the SM or so-called fundamental constants. These constants include the masses of elementary particles and the strengths of the forces of nature which combined govern the chemical complexity of our universe. What is probably most unsettling is that the values of constants can only be measured experimentally and any attempts to derive them from first principles have so far proven unsuccessful. Is it simply nature's last word or does it mean that the particular principles are yet to be discovered? Driven by this question, various propositions have been made where in alternate universes constants would take different values. In the meantime, the specific values of the fundamental constants featured by our universe continue to be the subject of great experimental scrutiny.

In this thesis, we explore the most basic question one can ask about a constant: is it actually constant? In particular, the focus of the present work is on the proton–electron mass ratio μ whose constancy is probed via spectroscopic measurements of sensitive transitions in molecular hydrogen and methanol found in distant galaxies and in white dwarf atmospheres.

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INVITATION

to attend the public defence
of the thesis

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mass ratio from
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and methanol

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at 13:45 at the Aula
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